NEXTera ENERGY SEABROOK

September 13, 2013

SBK-L-13162
Docket No. 50-443

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Seabrook Station
NextEra Energy Seabrook License Renewal Application
Alkali-Silica Reaction (ASR) Monitoring Program

References:

1. NextEra Energy Seabrook, LLC letter SBK-L-10077, "Seabrook Station Application for Renewed Operating License," May 25, 2010. (Accession Number ML101590099)
2. NextEra Energy Seabrook, LLC letter SBK-L-12101, "Seabrook Station NextEra Energy Seabrook License Renewal Application Structures Monitoring Program Supplement-Alkali-Silica Reaction (ASR) Monitoring," May 16, 2012 (Accession Number ML12142A323).
3. NextEra Energy Seabrook, LLC letter SBK-L-12217, "Seabrook Station Response to Request for Additional Information, NextEra Energy Seabrook License Renewal Application – Request for Additional Information," November 2, 2012 (Accession Number ML12312A017).
4. NextEra Energy Seabrook, LLC letter SBK-L-12247, "Clarification for Response to Follow up RAI B.2.1.31-1 Item (b)(2) provided in SBK-L-12217," November 20, 2012 (Accession Number ML12333A237).
5. NRC Letter, "Summary of Meeting Held on February 21, 2013, Between the US Nuclear Regulatory Commission and NextEra Energy Seabrook, LLC., Regarding the Seabrook Nuclear Power Station License Renewal Application (TAC NO. ME4028)," March 21, 2013 (Accession Number ML13066A488).
6. NextEra Energy Seabrook, LLC letter SBK-L-13055, "Response to Confirmatory Action Letter," May 15, 2013.
7. NextEra Energy Seabrook, LLC letter SBK-L-13080, "Response to Confirmatory Action Letter," May 1, 2013.

In Reference 1, NextEra Energy Seabrook, LLC (NextEra) submitted an application for a renewed facility operating license for Seabrook Station Unit 1 in accordance with the Code of Federal Regulations, Title 10, Parts 50, 51, and 54.



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In Reference 2, NextEra provided changes to the License Renewal Application (LRA) associated with managing the effects of Alkali-Silica Reaction. A plant specific Alkali-Silica Reaction (ASR) Monitoring Program, B.2.1.31A which augments the existing Structures Monitoring Program, B.2.1.31 was contained in this correspondence.

In References 3 and 4, NextEra provided supplemental information related to staff RAIs regarding the Alkali-Silica Reaction Monitoring Program.

On February 21, 2013, NRC Staff met with NextEra to discuss additional information that was needed in order to complete their review of the Alkali-Silica Reaction Monitoring Program. Notes of that meeting are provided in Reference 5.

In References 6 and 7, NextEra provided details of the Large Scale Test and Anchor Test Programs for ASR affected concrete.

Additional information based on the February 21, 2013 meeting with NRC Staff has been incorporated in this supplement to the License Renewal Application (LRA).

Enclosure 1 contains changes to LRA Appendix A – Updated UFSAR Supplement, and Appendix B – Aging Management Programs associated with the Alkali-Silica Reaction Monitoring Program.

The changes are explained, and where appropriate to facilitate understanding, portions of the LRA are repeated with the change highlighted by strikethroughs for deleted text and bolded italics for inserted text. In some instances the entire text of a section has been replaced or added. In these cases a note is included in the introduction indicating the replacement of the entire text of the section.

Commitment number 71 has been revised. There are no other new or revised regulatory commitments contained in this letter. Enclosure 2 provides a revised LRA Appendix A - Final Safety Report Supplement Table A.3, License Renewal Commitment List, updated to reflect the license renewal commitment changes made in NextEra Energy Seabrook correspondence to date.

If there are any questions or additional information is needed, please contact Mr. Richard R. Cliche, License Renewal Project Manager, at (603) 773-7003.

If you have any questions regarding this correspondence, please contact Mr. Michael Ossing Licensing Manager, at (603) 773-7512.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 13, 2013

Sincerely,

Kevin T. Walsh
Site Vice President
NextEra Energy Seabrook, LLC

Enclosures:

Enclosure 1- Changes to the Seabrook Station License Renewal Application Associated with Appendix A - Updated UFSAR Supplement, and Appendix B - Aging Management Programs

Enclosure 2- LRA Appendix A - Final Safety Report Supplement Table A.3, License Renewal Commitment List

cc:

| | |
|---|---|
| W.M. Dean, | NRC Region I Administrator |
| J. G. Lamb, | NRC Project Manager, Project Directorate I-2 |
| P. Cataldo | NRC Resident Inspector |
| R. A. Plasse Jr., | NRC Project Manager, License Renewal |
| L. M. James, | NRC Project Manager, License Renewal |

Director Homeland Security and Emergency Management
New Hampshire Department of Safety
Division of Homeland Security and Emergency Management
Bureau of Emergency Management
33 Hazen Drive
Concord, NH 03305

John Giarrusso, Jr., Nuclear Preparedness Manager
The Commonwealth of Massachusetts
Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

**Enclosure 1 to SBK-L-13162**

**Changes to the**

**Seabrook Station License Renewal Application**

**Associated with**

**Appendix A – Updated UFSAR Supplement**

**and**

**Appendix B – Aging Management Programs**

## Introduction

Enclosure 1 contains an update to the NextEra Energy Seabrook License Renewal Application (LRA), Appendix A and Appendix B. Included in this update are changes to information provided in References 2 and 3 relative to the plant specific Alkali-Silica Reaction (ASR) Monitoring Program, B.2.1.31A.

## CHANGES TO LRA APPENDIX A

The following changes have been made to Appendix A of the Seabrook License Renewal Application (LRA). For clarity, entire sentences or paragraphs from the LRA are provided with deleted text highlighted by strikethroughs and inserted text highlighted by bolded italics:

a) Revise section A.2.1.31A (Reference 2), as follows:

### A.2.1.31A ALKALI-SILICA REACTION (ASR) MONITORING

The Alkali-Silica Reaction (ASR) Monitoring Program manages cracking due to expansion and reaction with aggregates of concrete structures within the scope of license renewal. ***The potential impact of ASR on the structural strength and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel. These strains produce the associated cracking.*** The program is consistent with the ten elements of an acceptable aging management program as described in NUREG-1800 Appendix A.1, Section A.1.2.3 and Table A.1-1.

The Structural Monitoring Program performs visual inspections of the concrete structures at Seabrook for indications of the presence of alkali-silica reaction (ASR). ASR is detected by visual observation of cracking on the surface of the concrete. The cracking is typically accompanied by the presence of moisture and efflorescence. Concrete affected by expansive ASR is typically characterized by a network or "pattern" of cracks. ASR involves the formation of an alkali-silica gel which expands when exposed to water. Microcracking due to ASR is generated through forces applied by the expanding aggregate particles and/or swelling of the alkali-silica gel within and around the boundaries of reacting aggregate particles. The ASR gel may exude from the crack forming white secondary deposits at the concrete surface. The gel also often causes a dark discoloration of the cement paste surrounding the crack at the concrete surface. If pattern or map cracking typical of concrete affected by ASR is identified, an evaluation will be performed to determine further actions. ***Monitoring of crack growth is used to assess the long term implications of ASR and specify monitoring intervals.***

To manage the aging effects of ***ASR*** ~~cracking due to expansion and reaction with aggregates~~ in concrete structures, the existing Structures Monitoring Program, ~~B.2.1.31~~, has been augmented by this plant specific Alkali-Silica Reaction (ASR) Monitoring Program~~, B.2.1.31A~~. The ASR Monitoring Program is structured according to the guidelines in ACI 349.3R, ~~"Structural Condition Assessment of Buildings."~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

ASR is detected by visual observation of cracking on the surface of the concrete. The cracking is typically accompanied by the presence of moisture and efflorescence. Monitoring of crack growth is used to assess the long term implications of ASR and specify monitoring intervals.

A Combined Cracking Index (CCI) and Individual Crack Width criteria are established as thresholds at which structural evaluation is necessary. ***The Cracking Index is the summation of the crack widths on the horizontal or vertical sides of a 0.5m (20-inch) by 0.5m (20-inch) square on the ASR-affected concrete surface. The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest.*** ~~The CCI represents the expansion along the entire perimeter of the 20-inch by 20-inch square.~~ A CCI of less than the 1.0 mm/m and Individual Crack Width of less than 1.0 mm can be deemed acceptable with deficiencies. Deficiencies determined to be acceptable with further review are trended for evidence of further degradation. A CCI of 1.0 mm/m or greater, or an Individual Crack Width of 1.0 mm or greater requires structural evaluation.

The Alkali-Silica Reaction (ASR) Monitoring Program will ***continue to*** monitor ***surface cracking (CCI) of ASR impacted areas on the frequencies established in the program. Follow-up inspection of*** at least 20 locations that represent the highest CCI values recorded during the baseline inspections~~. these locations~~ will be performed at six month intervals.

***Large scale destructive testing of concrete beams with accelerated ASR confirms parameters being monitored are appropriate to manage the effects of ASR and that acceptance criteria used provides sufficient margin. Anchor bolt testing quantifies the impact of ASR on anchor capacity as a function of the severity of ASR degradation.***

b) Revise Commitment #71, Table A.3, "License Renewal Commitment List", (Reference 2), as follows:

A.3 LICENSE RENEWAL COMMITMENT LIST

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 71 | Alkali-Silica Reaction (ASR) Monitoring Program | Implement the Alkali-Silica Reaction (ASR) Monitoring Program. ***Testing will be performed to confirm that parameters being monitored and acceptance criteria used are appropriate to manage the effects of ASR.*** | A.2.1.31A | Prior to entering the period of extended operation. |

## CHANGES TO LRA APPENDIX B

The following changes have been made to Appendix B of the Seabrook License Renewal Application (LRA). For clarity, revised sections (Program Description and Elements 3 through 6 and 10) are included in their entirety. Changes are shown with deleted text highlighted by strikethroughs and inserted text highlighted by bolded italics:

a) Revise Section B.2.1.31A, Alkali-Silica Reaction (ASR) Monitoring Program (Reference 2), as follows:

### B.2.1.31A ALKALI-SILICA REACTION MONITORING PROGRAM

#### Program Description

NextEra Energy Seabrook Operating Experience (OE) indicates that Alkali-Silica Reaction (ASR) is present in concrete structures and will require monitoring through the Period of Extended Operation.

~~Alkali-Silica Reaction (ASR) is a reaction that occurs over time in concrete between alkaline cement paste and reactive, non-crystalline silica in aggregates. An expansive gel is formed within aggregates resulting in micro cracks in aggregates and in the adjacent cement paste.~~ ***Alkali-Silica Reaction (ASR) is an aging mechanism that may occur in concrete under certain circumstances. It is a reaction between the alkaline cement and reactive forms of silicate material (if present) in the aggregate. The reaction, which requires moisture to proceed, produces an expansive gel material. This expansion results in strains in the material that can produce micro-cracking in the aggregate and in the cement paste. The potential impact of ASR on the structural strength and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel. These strains produce the associated cracking.*** Because the ASR mechanism requires the presence of ***moisture in the concrete,*** ASR has been predominantly detected in groundwater impacted portions of below grade structures, with limited impact to exterior surfaces of above grade structures.

The ASR developed at Seabrook because the concrete mix designs utilized an aggregate that was susceptible to Alkali-Silica Reaction, which was not known at the time. Although the testing was conducted in accordance with the ASTM C289 standard, this standard was subsequently identified as limited in its ability to predict long term ASR.

***The plant specific Alkali-Silica Reaction (ASR) Monitoring Program manages cracking due to expansion and reaction with aggregates of concrete structures within the scope of license renewal. The potential impact of ASR on the structural strength and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel. These strains produce the associated cracking.*** To manage ~~the~~ ***these*** aging effects ~~of cracking due to expansion and reaction with aggregates in concrete structures~~, the existing Structures Monitoring Program, B.2.1.31, has been augmented by this plant specific Alkali-Silica Reaction (ASR) Monitoring Program, B.2.1.31A. The ASR Monitoring Program will be structured according to the guidelines in ACI 349.3R, ~~*"Structural*~~

~~Condition Assessment of Buildings."~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

Evaluations of a structure's condition are completed according to the guidelines set forth in the Structural Monitoring Program (the Seabrook Station Maintenance Rule program that implements the Structures Monitoring Program). The acceptance guidelines in the Structural Monitoring Program are a three-tier hierarchy similar to that described in ACI 349.3R~~-96~~, which provides quantitative degradation limits. Under this system, structures are evaluated for ASR as detailed in the following Table. ASR affected areas classified to be Unacceptable (requires further evaluation) or Acceptable with Deficiencies are monitored in accordance with the Alkali-Silica Reaction (ASR) Monitoring Program.

| Structural Monitoring Program Categories | Recommendation for Individual Concrete Components | Combined Cracking Index, CCI | Individual Crack Width |
|---|---|---|---|
| Unacceptable (requires further evaluation) | Structural Evaluation | 1.0 mm/m or greater | 1.0 mm or greater |
| Acceptable with Deficiencies | Quantitative Monitoring and Trending | 0.5 mm/m or greater | 0.2 mm or greater |
| | Qualitative Monitoring | Any area with indications of pattern cracking or water ingress | |
| Acceptable | Routine inspection as prescribed by Structures Monitoring Program | Area has no indications of pattern cracking or water ingress – No visual presence of ASR | |

Industry Expert Engagement

Alkali-Silica Reaction is a newly identified aging mechanism to Seabrook and little or no experience exists in management of its aging effects in the US nuclear industry. NextEra has engaged several subject matter experts with knowledge of ASR and its impact on concrete structures. Based on this expertise, NextEra has concluded that the mechanical properties of the in-situ structures, that are highly reinforced with rebar steel, are expected to be higher than the results from core bore testing (4" concrete bore with no rebar).

Principle references used in development of this aging management program consist of the following input of subject matter experts and both nuclear and non-nuclear sources:

- "Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures," U.S. Dept. of Transportation, Federal Highway Administration, January 2010, Report Number FHWA-HIF-09-004.
- "Structural Effects of Alkali-Silica Reaction: Technical Guidance on the Appraisal of Existing Structures," Institution of Structural Engineers, July 1992.

- ORNL/NRC/LTR-95/14, "In-Service Inspection Guidelines for Concrete Structures in Nuclear Power Plants," December 1995."
- "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments", MPR-3727, Revision 0, April 2012.

Monitoring

Monitoring of ASR associated cracks is an effective method for determining ASR progression. Monitoring of ASR associated cracks at Seabrook is implemented with two measurements. One is Cracking Index (CI) and the other is Individual Crack Width.

The CI is a quantitative assessment of cracking present in the cover concrete of affected structures. A CI measurement is taken on accessible surfaces exhibiting ASR pattern cracking. The process for determining the Cracking Index (CI) is described in the Federal Highway Administration (FHWA) document FHWA-HIF-09-004, *"Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction (ASR) in Transportation Structures."* The ***FHWA*** Cracking Index is the summation of the crack widths on the horizontal or vertical sides of a ***0.5m*** (20-inch) by ***0.5m*** (20-inch) square on the ASR-affected concrete surface. Since each side of the square is 0.5 m, the Cracking Index in a given direction is reported in units of mm/m.

The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest. ~~The CCI represents the expansion along the entire perimeter of the 20-inch by 20-inch square.~~ Criteria used in assessment of expansion is expressed in terms of CCI and based on recommendations provided in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*. The CCI and individual crack width are compared to ASR screening criteria and categorized for Qualitative or Quantitative Monitoring and Trending and Structural Evaluation.

The progression of ASR degradation of the concrete is an important consideration for assessing the long term implications of ASR and specifying monitoring intervals. The most reliable means for establishing the progression of ASR degradation is to monitor expansion of the ***in situ*** concrete ~~*in-situ*~~.

Individual Crack Width measurement is also an effective method for assessment of ASR affected areas. Screening criteria used in the assessment of Individual Crack Width, expressed in terms of mm, are based on recommendations provided in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*.

NextEra has performed a baseline inspection and ASR associated cracks have been evaluated and categorized. NextEra has assessed 131 accessible areas to date in this manner. The areas affected by ASR have been identified and assessed for apparent degradation from ASR, including estimation of in situ expansion. The results are presented in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*. Monitoring of Cracking Index and Individual Crack Width of at least 20 areas identified in the baseline inspection as having the largest CCI will be performed at six month intervals.. Trend data from these follow-up inspections will be used in determining the progression of ASR degradation and a basis for any change to the frequency of the inspection of ASR affected areas. Documentation and trend data will be maintained in accordance with the Structures Monitoring Program and established guidelines of ACI 349.3R, ~~*"Structural Condition Assessment of Buildings."*~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

***Basis for use of the crack index methodology is as follows:***

***ASR produces a gel that expands as it absorbs moisture. This expansion exerts a tensile stress on the surrounding concrete which strains the concrete and eventually results in cracking.***

***The engineering strain in a structural member at the time of crack initiation ($\varepsilon_{cr}$) is equivalent to the tensile strength of the concrete divided by the elastic modulus ($\varepsilon_{cr} = \sigma_t / E$). The Cracking Index quantifies the extent of the surface cracking. The total strain in the concrete can be approximated as the sum of the strain at crack initiation plus the cracking index ($\varepsilon \approx \varepsilon_{cr}$ + CI). Figure A-1 depicts a concrete specimen with rebar being put in tension resulting in cracking.***

***Concrete has little strain capacity; therefore, in ASR-affected concrete, the crack widths comprise most of the expansion ($\Delta L$). As a result, even though the Cracking Index does not account for strain in the un-cracked concrete between cracks ($\varepsilon_{bc}$), the Cracking Index provides a reasonable approximation of the total strain applied to the concrete after crack initiation.***

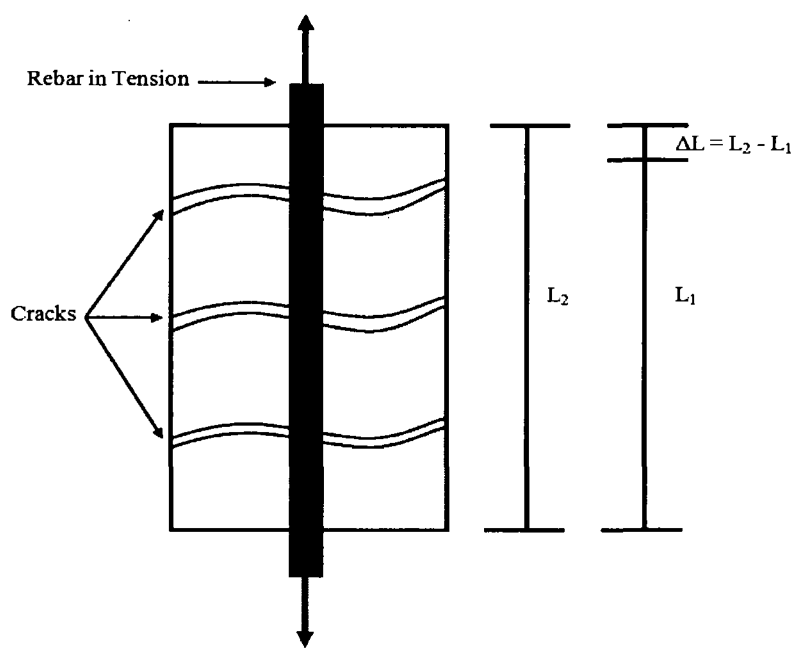


***Figure A-1. Concrete Specimen put in Tension***

*For surfaces where horizontal and vertical cracking indices are similar (e.g., where there is equivalent reinforcement in both directions), a Combined Cracking Index (CCI) that averages the horizontal and vertical Cracking Indices can consolidate the expansion assessment to a single parameter.*

*__Large Scale Testing__*

*While the monitoring program action levels are currently based on the generic information available in the literature, a full scale testing program has been undertaken to refine the impacts for structures similar to those impacted by ASR at Seabrook Station. The purpose of the testing is to quantify the impact of ASR on structural performance for varied degrees of ASR-affected reinforced concrete that can be correlated to the ASR-affected concrete structures at Seabrook Station. In particular, test programs will focus on shear and reinforcement anchorage. Specific objectives of the testing are as follows:*

- *Determine the extent to which the shear performance, development length of reinforcement, and flexural stiffness of reinforced concrete beams are affected as a function of ASR-related expansion.*
- *Determine the effectiveness of retrofit techniques in the enhancement of shear performance and on the development length in reinforced concrete beams.*

*Large scale destructive testing of concrete beams with accelerated ASR will be conducted to determine actual structural impact of ASR. Structural performance will be established based on correlation between the structural testing results and observed expansion levels/crack mapping. Large scale tests will confirm that parameters being monitored are appropriate to manage the effects of ASR and that acceptance criteria used provides sufficient margin.*

*The potential impact of ASR on the structural strength of concrete is a consequence of strains resulting from the expansive gel. A direct method of monitoring ASR impact to a structural element would be to measure the accumulated strain. Because strain measuring devices were not installed during original construction, the accumulated strain to date cannot be directly measured. However, cracking can be used as an indication of accumulated strain. Monitoring of surface cracking and specifically crack mapping is the most effective way to correlate the accumulated expansion in the structures.*

*NextEra Energy is currently using the CCI method to monitor and trend ASR expansion at Seabrook Station. The CCI is well-suited as a correlating parameter between the test specimens and reinforced concrete surfaces at Seabrook Station.*

*Core bores will be obtained from the test specimens for petrographic examination to confirm the presence of ASR. Qualitative assessments of the severity of ASR will also be performed, including a comparison of the severity of ASR through the depth of the test specimen. These assessments will use both the*

***visual assessment rating and the damage rating index, both of which have been used in evaluation of cores from Seabrook Station. This petrographic examination will further validate the CCI correlation between test and in situ measurements.***

***In addition to large scale destructive testing of concrete beams, anchor testing will be performed to quantify the impact of ASR on anchor capacity as a function of the severity of ASR degradation.***

***In the event these test results indicate a need to amend the monitoring program, NextEra will take such action.***

Acceptance Criteria

Several published studies describe screening methods to determine when structural evaluations of ASR affected concrete are appropriate and how to prioritize such evaluations. In MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*, these studies were reviewed for applicability. The report concludes: *"while these screening methods are based on lightly or unreinforced concrete structures, they are useful in the absence of criteria directly relevant to the highly-reinforced concrete structures used in nuclear generating facilities,"* and, *"Confinement provided by reinforcing steel and other restraints is a key factor regarding the impact of ASR on reinforced concrete structures. Confinement limits ASR expansion of the in situ structure, which reduces the extent of deleterious cracking and the resultant reduction in concrete properties."*

NextEra has performed a baseline inspection and ASR associated cracks have been evaluated and categorized. NextEra has assessed 131 accessible areas to date in this manner. The areas affected by ASR have been identified and assessed for apparent degradation from ASR, including estimation of in situ expansion. The results are presented in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*. This report provides recommendations and the basis for thresholds used in the Alkali-Silica Reaction (ASR) Monitoring Program. The ASR Monitoring Program establishes the screening criteria for ASR affected areas. ASR affected areas are screened and categorized for Qualitative or Quantitative Monitoring and Trending and Structural Evaluation.

A Combined Cracking Index (CCI) of less than the 1.0 mm/m and Individual Crack Width of less than 1.0 mm can be deemed Acceptable with Deficiencies. Areas with deficiencies determined to be acceptable with further review are trended for evidence of further degradation. Documentation and trend data will be maintained in accordance with the Structures Monitoring Program and established guidelines of ACI 349.3R, ~~*"Structural Condition Assessment of Buildings."*~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

Areas with a CCI of 1.0 mm/m or greater, or an Individual Crack Width of 1.0 mm or greater are deemed unacceptable and require a structural evaluation. This evaluation is performed to ensure impacted structures are in compliance with the Current Licensing Basis and is documented in the Corrective Action Program. The engineering evaluation will be typical to those structural evaluations that have already been performed for Alkali-Silica Reaction. The Engineering Evaluation will consider the need to perform a detailed appraisal to determine potential capacity reductions, or the need to perform special studies, testing, and monitoring. Additionally, Corrective Actions requiring repair are entered in the Work Control Program for implementation.

Evaluation

Evaluations are performed to ensure impacted structures are in compliance with the Current Licensing Basis. These evaluations are documented in the Corrective Action Program. Additionally, Corrective Actions requiring repair are entered in the Work Control Program for implementation. Deficiencies determined to be acceptable by engineering review are trended for evidence of further degradation.

Conclusion

To manage the aging effects of cracking due to expansion and reaction with aggregates in concrete structures, the existing Structures Monitoring Program, B.2.1.31, has been augmented by this plant specific Alkali-Silica Reaction (ASR) Monitoring Program, B.2.1.31A. The ASR Monitoring Program will be structured according to the guidelines in ACI 349.3R, ~~*"Structural Condition Assessment of Buildings."*~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

A Combined Cracking Index (CCI) of less than the 1.0 mm/m and Individual Crack Width of less than 1.0 mm can be deemed Acceptable with Deficiencies. Areas with deficiencies determined to be acceptable with further review are trended for evidence of further degradation. A CCI of 1.0 mm/m or greater, or an Individual Crack Width of 1.0 mm or greater are deemed Unacceptable and require further evaluation.

NextEra has performed a baseline inspection and ASR associated cracks have been evaluated and categorized. NextEra has assessed 131 accessible areas to date in this manner. The areas affected by ASR have been identified and assessed for apparent degradation from ASR, including estimation of in situ expansion. Monitoring of CI and Individual Crack Width of at least 20 areas identified in the baseline inspection as having the CCI will be performed at six month intervals. Measurement of Cracking Index and Individual Crack Width will be performed in the same areas as the baseline. Trend data from these follow-up inspections will be used in determining the progression of ASR and a basis for any change to the frequency of the inspection.

**Program Elements**

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ELEMENT 3 - PARAMETERS MONITORED/INSPECTED

The Alkali-Silica Reaction (ASR) Monitoring Program manages the effects of cracking due to expansion and reaction with aggregates. ***The potential impact of ASR on the structural strength and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel. These strains produce the associated cracking.***

The program focuses on identifying evidence of ASR, either past or present, which could lead to expansion due to reaction with aggregates. The program is consistent with published guidance for condition assessment of structures affected by ASR.

ASR is detected by visual observation of cracking on the surface of the concrete. The cracking is typically accompanied by the presence of moisture and efflorescence. Concrete affected by expansive ASR is typically characterized by a network or "pattern" of cracks. ASR involves the formation of an alkali-silica gel which expands when exposed to water. Microcracking due to ASR is generated through forces applied by the expanding aggregate particles and/or swelling of the alkali-silica gel within and around the boundaries of reacting aggregate particles. The ASR gel may exude from the crack forming white secondary deposits at the concrete surface. The gel also often causes a dark discoloration of the cement paste surrounding the crack at the concrete surface. Visual observation of the conditions described above is used to identify the presence of ASR.

Cracking Index

A Cracking Index is determined for accessible surfaces exhibiting ASR pattern cracking. The process for determining the Cracking Index (CI) is described in the Federal Highway Administration (FHWA) document FHWA-HIF-09-004, *"Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction (ASR) in Transportation Structures."* The ***FHWA*** Cracking Index is the summation of the crack widths on the horizontal or vertical sides of a ***0.5m*** (20-inch) by ***0.5m*** (20-inch) square on the ASR-affected concrete surface. Since each side of the square is 0.5 m, the Cracking Index in a given direction is reported in units of mm/m.

The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest~~. The CCI represents the expansion along the entire perimeter of the 20-inch by 20-inch square~~. Screening criteria used in the assessment of expansion is expressed in terms of CCI and based on recommendations provided in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments.*

The progression of ASR degradation of the concrete is an important consideration for assessing the long term implications of ASR and specifying monitoring intervals. The most reliable means for establishing the progression of ASR is to monitor expansion of the ***in situ*** concrete ~~*in situ*~~.

Crack Width

Crack Width is a measurement of an individual crack width and is reported in units of mm. Progression of ASR is monitored by periodically measuring the individual crack width. Screening criteria used in the assessment of individual crack width are based on recommendations provided in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments.*

ELEMENT 4 - DETECTION OF AGING EFFECTS

ASR is detected by visual inspections performed by qualified individuals. These individuals must either be a licensed Professional Engineer experienced in this area, or will work under the direction of a licensed Professional Engineer.

The Seabrook Station Alkali-Silica Reaction (ASR) Monitoring Program provides for management of aging effects due to the presence of ASR. Program scope includes concrete structures within the scope of License Renewal.

ASR is a reaction that occurs within the structure of the concrete due to the reaction between silica from the aggregate and alkali constituents in the cement. The reaction produces a gel that expands as it absorbs moisture. Expansion of the gel exerts tensile stress on the concrete resulting in cracking. ***Surface cracking is a direct physical manifestation of the expansion induced by ASR within the core of the structural member.***

The cracking propagates on the surface of the concrete where it is visually identifiable. ***The degree of cracking is most severe at the surface of the concrete due to several factors. The surface or cover concrete extends beyond the steel reinforcing bars. Because this surface is not within the steel reinforced part of the wall, the concrete is free to expand as the ASR gel is formed and ultimately expands. Additionally, the surface of the wall is subject to wetting and drying which can increase the flow of alkalis in this area. Consequently, the exposed surface will experience the largest and most visible cracking. This makes monitoring of the surface cracks an appropriate and reliable diagnostic tool for monitoring the progression of ASR.***

Typical cracking resulting from ASR is described as "pattern" or "map" cracking and is usually accompanied by a dark staining adjacent to the cracks at the surface of the structure. The ASR gel may exude from the crack forming white secondary deposits at the concrete surface. Visual indications of pattern cracking, which are often accompanied by staining or residual gel deposits, are documented and evaluated as deficiencies. To identify and verify the presence of ASR, the maximum crack width, a cracking index, and a description of the cracking including any visible surface discoloration are documented. Documentation and trend data will be maintained in accordance with the Structural Monitoring Program and established guidelines of ACI 349.3R, ~~*"Structural Condition Assessment of Buildings."*~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

ELEMENT 5 - MONITORING AND TRENDING

Monitoring of ASR associated cracks is an effective method for determining ASR progression. Monitoring of ASR associated cracks at Seabrook is implemented with two measurements. One is Cracking Index (CI) and the other is Individual Crack Width.

The CI is a quantitative assessment of cracking present in the cover concrete of affected structures. A CI measurement is taken on accessible surfaces exhibiting ASR pattern cracking. The process for determining the Cracking Index (CI) is described in the Federal Highway Administration (FHWA) document FHWA-HIF-09-004, *"Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction (ASR) in Transportation Structures."* The ***FHWA*** Cracking Index is the summation of the crack widths on the horizontal or vertical sides of a ***0.5m*** (20-inch) by ***0.5m*** (20-inch) square on the ASR-affected concrete surface. Since each side of the square is 0.5 m, the Cracking Index in a given direction is reported in units of mm/m.

The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest. ~~The CCI represents the expansion along the entire perimeter of the 20-inch by 20-inch square.~~ Screening criteria used in the assessment of expansion is expressed in terms of CCI and based on recommendations provided in MPR-3727, Revision 0, *Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*. The CCI is compared to screening criteria and trended to establish the progression of ASR degradation.

The progression of ASR degradation of the concrete is an important consideration for assessing the long term implications of ASR and specifying monitoring intervals. The most reliable means for establishing the progression of degradation is to monitor expansion of the concrete *in situ*.

Individual Crack Width measurement is also an effective method for assessment of ASR affected areas. Screening criteria used in the assessment of Individual Crack Width, expressed in terms of mm, are based on recommendations provided in MPR-3727, Revision 0, "*Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*."

NextEra has performed a baseline inspection and ASR associated cracks have been evaluated and categorized. NextEra has assessed 131 accessible areas to date in this manner. The areas affected by ASR have been identified and assessed for apparent degradation from ASR, including estimation of in situ expansion. The results are presented in MPR-3727, Revision 0, "*Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments*." Monitoring of Cracking Index and Individual Crack Width of at least 20 areas identified in the baseline inspection as having the largest CCI will be performed at six month intervals. Measurement of Cracking Index and Individual Crack Width will be performed in the same areas as the baseline. Trend data from ~~these~~ follow-up inspections ~~will be~~ ***is*** used in determining the progression of expansion and a basis for any change to the frequency of the inspection. Documentation and trend data will be maintained in accordance with the Structural Monitoring Program and established guidelines of ACI 349.3R, ~~"*Structural Condition Assessment of Buildings.*"~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

Deficiencies being repaired or trended are subject to follow-up inspections of increased frequency. Newly discovered areas exhibiting visual signs of ASR are identified during routinely performed Structural Monitoring Program inspections and documented as deficiencies. Deficiencies are reviewed in accordance with the Structural Monitoring Program and established guidelines of ACI 349.3R, ~~"*Structural Condition Assessment of Buildings.*"~~ ***"Evaluation of Existing Nuclear Safety-Related Concrete Structures."***

ELEMENT 6 - ACCEPTANCE CRITERIA

Several published studies describe screening methods to determine when structural evaluations of ASR affected concrete are appropriate and how to prioritize such evaluations. In MPR-3727, Revision 0, "*Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments,*" these studies were reviewed for applicability. The report concludes: "*while these screening methods are based on lightly or unreinforced concrete structures, they are useful in the absence of criteria directly relevant to the highly-reinforced concrete structures used in nuclear generating facilities,*" and, "*Confinement provided by reinforcing steel and other restraints is a key factor regarding the impact of ASR on reinforced concrete structures. Confinement limits ASR expansion of the in situ structure, which reduces the extent of deleterious cracking and the resultant reduction in concrete properties.*"

NextEra has performed a baseline inspection and ASR associated cracks have been evaluated and categorized. NextEra has assessed 131 accessible areas to date in this manner. The areas affected by ASR have been identified and assessed for apparent degradation from ASR, including estimation of in situ expansion. The results are presented in MPR-3727, Revision 0, "*Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments.*" Based on site specific assessment and review of industry source documentation this report provides recommendations for screening thresholds used in the Alkali-Silica Reaction (ASR) Monitoring Program. Using these thresholds, ASR affected areas are screened and categorized for Qualitative or Quantitative Monitoring and Trending and Structural Evaluation.

A Combined Cracking Index (CCI) of less than the 1.0 mm/m and Individual Crack Width of less than 1.0 mm can be deemed Acceptable with Deficiencies. Areas with deficiencies determined to be acceptable with further review are trended for evidence of further degradation.

A CCI of 1.0 mm/m or greater, or an Individual Crack Width of 1.0 mm or greater are deemed Unacceptable and require a structural evaluation. Structural evaluations are performed to ensure impacted structures are in compliance with the

Current Licensing Basis are documented in the Corrective Action Program. The engineering evaluation will be typical to those structural evaluations that have already been performed for Alkali-Silica Reaction. The Engineering Evaluation will consider the need to perform a detailed appraisal to determine potential capacity reductions, or the need to perform special studies, testing, and monitoring. Additionally, Corrective Actions requiring repair are entered in the Work Control Program for implementation.

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ELEMENT 10 - OPERATING EXPERIENCE

The primary source of OE, both industry and plant specific, was the Seabrook Station Corrective Action Program documentation. The Seabrook Station Corrective Action Program is used to document review of relevant external OE including INPO documents, NRC communications and Westinghouse documents, and plant specific OE including corrective actions, maintenance work orders generated in response to a structure, system or component deficiencies, system and program health reports, self-assessment reports and NRC and INPO inspection reports.

The Seabrook Station Corrective Action Program is used to track, trend and evaluate plant issues and events. Those issues and events, whether external or plant specific, that are potentially significant to the ASR Monitoring Program are evaluated. The ASR Monitoring Program is revised, as appropriate, if these evaluations show that program changes will enhance program effectiveness.

Historically, NextEra Energy Seabrook (NextEra) has experienced groundwater infiltration through cracks, capillaries, pore spaces, seismic isolation joints, and construction joints in the below grade walls of concrete structures. Some of these areas have shown signs of leaching, cracking, and efflorescence on the concrete due to the infiltration. During the early 1990's an evaluation was conducted to assess the effect of the groundwater infiltration on the serviceability of the concrete walls. That evaluation concluded that there would be no deleterious effect, based on the design and placement of the concrete and on the non-aggressive nature of the groundwater.

In 2009, NextEra tested seasonal groundwater samples to support the development of a License Renewal Application. The results showed that the groundwater had become aggressive and NextEra initiated a comprehensive review of possible effects to in-scope structures.

A qualitative walkdown of plant structures was performed and the "B" Electrical Tunnel was identified as showing the most severe indications of groundwater infiltration. Concrete core samples from this area were removed, tested for strength and elasticity values, and subjected to petrographic examinations. While the results showed that both strength and elasticity values had declined, they remained within the design margin. The results of the petrographic examinations also showed that the samples had experienced Alkali-Silica Reaction (ASR).

NextEra initiated an extent of condition evaluation and concrete core samples were taken from five additional areas of the plant - areas that showed characteristics with the greatest similarity to the "B" Electrical Tunnel. Additional concrete core samples were also taken from an expanded area around the original concrete core samples in the "B" Electrical Tunnel.

Tests on these core samples confirmed that the original "B" Electrical Tunnel core samples show the most significant ASR. For the five additional areas under investigation, final results of compressive strength and modulus testing indicate that the compressive strength in all areas is greater than the strength required by the design of the structures. Modulus of elasticity was in the range of the expected value except for the Diesel Generator, Containment Enclosure Buildings, Emergency Feedwater Pumphouse, and the Equipment Vaults which were less than the expected value in localized areas.

Evaluation of the test results shows that the affected structures to be fully capable of performing their safety function but margin had been reduced. The areas are potentially subject to further degradation of material properties due to the effects of ASR.

A review of industry related operating experience related to ASR was performed. The review includes NRC generic communications issued such as Generic Letters, Bulletins, and Information Notices. Industry operating experience is discussed below:

1. In 1994, ASTM Standard C289 was clarified to caution that the tests described may not accurately predict aggregate reactivity when dealing with late- or slow-expanding aggregates containing strained quartz or microcrystalline quartz.
2. On August 4, 2010, NRC issued Information Notice (IN) 2010-14 "Containment Concrete Surface Condition Examination Frequency and Acceptance Criteria." Seabrook's assessment resulted in updating the IWL program with inspection guidelines typical to ACI 349.3R.
3. OE 34348 Operating Experience report submitted by NextEra: Preliminary - Reduction in Concrete Properties Due to Distress from Alkali-Silica Reaction (ASR) was issued September 30, 2011.
4. On November 11, 2011, NRC issued Information Notice (IN) 2011-20, "Concrete Degradation by Alkali-Silica Reaction" to notify the industry based on the Seabrook issue.

The Seabrook Station plant specific operating experience identified the following:

1. As part of the Seabrook License Renewal process, the aggressiveness of the groundwater chemistry on concrete structures in contact with groundwater/soil must be determined. The first two samples collected in June 2009 from well locations indicate Chloride levels >500 PPM. Since the chloride levels exceed the acceptable limits, the groundwater was considered aggressive. Groundwater chemistry is now being performed

every five years via the Structures Monitoring Program and awareness of the aggressive water chemistry is considered in the inspection of concrete.

2. Concrete core samples were removed from the Control Building B-Electrical Tunnel in April 2010 and Penetration Resistance Tests (PRT) performed. The results of the PRT indicated an average concrete compressive strength of 5340 psi and the concrete core testing indicated an average compressive strength of 4790 psi. An engineering evaluation was performed to review the results of core samples. The results show the structure to be fully capable of performing its safety function but margin had been reduced.

3. In September 2010, Testing was completed on concrete core samples removed from the walls at elevation (-) 20' in the Control Building B-Electrical Tunnel. The results of the modulus testing indicate that the average measured elastic modulus to be less than the expected elastic modulus. An engineering evaluation was performed to review the results of core samples. The results showed the structure to be fully capable of performing its safety function but margin had been reduced. Results of the petrographic examination completed in September 2010 showed that the samples had experienced Alkali-Silica Reaction (ASR).

4. Inspection performed April 2011 on elevation (-) 30' in the Containment CEVA identified a craze cracking pattern on a localized area of the Containment concrete shell. The observed craze cracks are tight, less than 40 mils width and contain fine dry white deposits. There were no other indications of degradation or distress in the concrete in this area. Craze cracking with white deposits suggests the presence of alkali-silica reaction. Additional inspections of the exterior face of the Containment Structure were performed in September 2011. These two locations have been included in the second-tier evaluation criteria of the program due to the past groundwater in-leakage and follow-up inspections will be performed. Any identified crack growth will require additional evaluation. NextEra has previously committed to maintaining the exterior surface of the Containment Structure in a dewatered state (LRA Commitment #52).

5. In June 2011, as an extent of condition evaluation, five (5) building structures were investigated to determine if the building concrete was affected by alkali-silica reaction (ASR). The five (5) building structures were selected based on visual indications on the inside concrete surfaces and exposure to groundwater infiltration. An engineering evaluation was performed to review the results of concrete core samples. The results show these structures to be fully capable of performing their safety function but margin had been reduced. A root cause evaluation was performed to determine how the ASR developed and why its presence was not identified until 2010. The following root causes were identified:

   - The ASR developed because the concrete mix designs utilized an aggregate that was susceptible to Alkali-Silica Reaction, which was not known at the time. Although the testing was conducted in accordance with ASTM standards, those testing standards were subsequently identified as limited in their ability to predict long term ASR.

- The health monitoring program for systems and structures does not contain a process for periodic reassessment of failure modes that were excluded from the monitoring criteria to ensure that the monitoring/mitigating strategies remain applicable and effective.

6. *In April 2012, results were published of accessible area inspections performed to identify and categorize locations of ASR distress. The areas affected by ASR have been identified and assessed for apparent degradation from ASR, including estimation of in situ expansion. The results are presented in MPR-3727, Revision 0, Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments.*

   *There were approximately 131 localized accessible areas with ASR distress. At least 20 areas having a Combined Cracking Index of 1.0 mm/m or greater were categorized as requiring "Further Evaluation" and follow-up inspections are performed every six months. Follow-up inspection of these areas performed in June 2012, December 2012 and June 2013 show no notable expansion of concrete due to ASR distress.*

   *Areas that were designated ASR "Acceptable with deficiencies" have a follow-up inspection frequency of 2 ½ years.*

   *Trend data from these follow-up inspections will be used in determining the progression of ASR degradation and a basis for any change to the frequency of the inspection of ASR affected areas.*

7. *In October 2012, a structural evaluation was performed to assess observed cracking at Azimuth $270^0$ of the containment building. The observed cracking meets the Tier 3 criteria which necessitates a structural evaluation. Although pattern cracking was noted at this location, the cracked area does not exhibit other indications of ASR (e.g., staining, deposits, etc.). Nevertheless, it was conservatively treated as if it were ASR and a structural evaluation was performed which concluded that containment is fully capable of meeting all its design functions.*

Enclosure 2 to SBK-L-13162

**LRA Appendix A - Final Safety Report Supplement Table A.3, License Renewal Commitment List Updated to Reflect Changes**

A.3 LICENSE RENEWAL COMMITMENT LIST

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 1. | PWR Vessel Internals | An inspection plan for Reactor Vessel Internals will be submitted for NRC review and approval. | A.2.1.7 | Program to be implemented prior to the period of extended operation. Inspection plan to be submitted to NRC not later than 2 years after receipt of the renewed license or not less than 24 months prior to the period of extended operation, whichever comes first. |
| 2. | Closed-Cycle Cooling Water | Enhance the program to include visual inspection for cracking, loss of material and fouling when the in-scope systems are opened for maintenance. | A.2.1.12 | Prior to the period of extended operation |
| 3. | Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems | Enhance the program to monitor general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system. | A.2.1.13 | Prior to the period of extended operation |
| 4. | Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems | Enhance the program to list additional cranes for monitoring. | A.2.1.13 | Prior to the period of extended operation |
| 5. | Compressed Air Monitoring | Enhance the program to include an annual air quality test requirement for the Diesel Generator compressed air sub system. | A.2.1.14 | Prior to the period of extended operation |
| 6. | Fire Protection | Enhance the program to perform visual inspection of penetration seals by a fire protection qualified inspector. | A.2.1.15 | Prior to the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 7. | Fire Protection | Enhance the program to add inspection requirements such as spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates by qualified inspector. | A.2.1.15 | Prior to the period of extended operation. |
| 8. | Fire Protection | Enhance the program to include the performance of visual inspection of fire-rated doors by a fire protection qualified inspector. | A.2.1.15 | Prior to the period of extended operation. |
| 9. | Fire Water System | Enhance the program to include NFPA 25 guidance for "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing". | A.2.1.16 | Prior to the period of extended operation. |
| 10. | Fire Water System | Enhance the program to include the performance of periodic flow testing of the fire water system in accordance with the guidance of NFPA 25. | A.2.1.16 | Prior to the period of extended operation. |
| 11. | Fire Water System | Enhance the program to include the performance of periodic visual or volumetric inspection of the internal surface of the fire protection system upon each entry to the system for routine or corrective maintenance. These inspections will be documented and trended to determine if a representative number of inspections have been performed prior to the period of extended operation. If a representative number of inspections have not been performed prior to the period of extended operation, focused inspections will be conducted. These inspections will be performed within ten years prior to the period of extended operation. | A.2.1.16 | Within ten years prior to the period of extended operation. |
| 12. | Aboveground Steel Tanks | Enhance the program to include components and aging effects required by the Aboveground Steel Tanks. | A.2.1.17 | Prior to the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 13. | Aboveground Steel Tanks | Enhance the program to include an ultrasonic inspection and evaluation of the internal bottom surface of the two Fire Protection Water Storage Tanks. | A.2.1.17 | Within ten years prior to the period of extended operation. |
| 14. | Fuel Oil Chemistry | Enhance program to add requirements to 1) sample and analyze new fuel deliveries for biodiesel prior to offloading to the Auxiliary Boiler fuel oil storage tank and 2) periodically sample stored fuel in the Auxiliary Boiler fuel oil storage tank. | A.2.1.18 | Prior to the period of extended operation. |
| 15. | Fuel Oil Chemistry | Enhance the program to add requirements to check for the presence of water in the Auxiliary Boiler fuel oil storage tank at least once per quarter and to remove water as necessary. | A.2.1.18 | Prior to the period of extended operation. |
| 16. | Fuel Oil Chemistry | Enhance the program to require draining, cleaning and inspection of the diesel fire pump fuel oil day tanks on a frequency of at least once every ten years. | A.2.1.18 | Prior to the period of extended operation. |
| 17. | Fuel Oil Chemistry | Enhance the program to require ultrasonic thickness measurement of the tank bottom during the 10-year draining, cleaning and inspection of the Diesel Generator fuel oil storage tanks, Diesel Generator fuel oil day tanks, diesel fire pump fuel oil day tanks and auxiliary boiler fuel oil storage tank. | A.2.1.18 | Prior to the period of extended operation. |
| 18. | Reactor Vessel Surveillance | Enhance the program to specify that all pulled and tested capsules, unless discarded before August 31, 2000, are placed in storage. | A.2.1.19 | Prior to the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 19. | Reactor Vessel Surveillance | Enhance the program to specify that if plant operations exceed the limitations or bounds defined by the Reactor Vessel Surveillance Program, such as operating at a lower cold leg temperature or higher fluence, the impact of plant operation changes on the extent of Reactor Vessel embrittlement will be evaluated and the NRC will be notified. | A.2.1.19 | Prior to the period of extended operation. |
| 20. | Reactor Vessel Surveillance | Enhance the program as necessary to ensure the appropriate withdrawal schedule for capsules remaining in the vessel such that one capsule will be withdrawn at an outage in which the capsule receives a neutron fluence that meets the schedule requirements of 10 CFR 50 Appendix H and ASTM E185-82 and that bounds the 60-year fluence, and the remaining capsule(s) will be removed from the vessel unless determined to provide meaningful metallurgical data. | A.2.1.19 | Prior to the period of extended operation. |
| 21. | Reactor Vessel Surveillance | Enhance the program to ensure that any capsule removed, without the intent to test it, is stored in a manner which maintains it in a condition which would permit its future use, including during the period of extended operation. | A.2.1.19 | Prior to the period of extended operation. |
| 22. | One-Time Inspection | Implement the One Time Inspection Program. | A.2.1.20 | Within ten years prior to the period of extended operation. |
| 23. | Selective Leaching of Materials | Implement the Selective Leaching of Materials Program. The program will include a one-time inspection of selected components where selective leaching has not been identified and periodic inspections of selected components where selective leaching has been identified. | A.2.1.21 | Within five years prior to the period of extended operation. |
| 24. | Buried Piping And Tanks Inspection | Implement the Buried Piping And Tanks Inspection Program. | A.2.1.22 | Within ten years prior to entering the period of extended operation |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 25. | One-Time Inspection of ASME Code Class 1 Small Bore-Piping | Implement the One-Time Inspection of ASME Code Class 1 Small Bore-Piping Program. | A.2.1.23 | Within ten years prior to the period of extended operation. |
| 26. | External Surfaces Monitoring | Enhance the program to specifically address the scope of the program, relevant degradation mechanisms and effects of interest, the refueling outage inspection frequency, the inspections of opportunity for possible corrosion under insulation, the training requirements for inspectors and the required periodic reviews to determine program effectiveness. | A.2.1.24 | Prior to the period of extended operation. |
| 27. | Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components | Implement the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program. | A.2.1.25 | Prior to the period of extended operation. |
| 28. | Lubricating Oil Analysis | Enhance the program to add required equipment, lube oil analysis required, sampling frequency, and periodic oil changes. | A.2.1.26 | Prior to the period of extended operation. |
| 29. | Lubricating Oil Analysis | Enhance the program to sample the oil for the Reactor Coolant pump oil collection tanks. | A.2.1.26 | Prior to the period of extended operation. |
| 30. | Lubricating Oil Analysis | Enhance the program to require the performance of a one-time ultrasonic thickness measurement of the lower portion of the Reactor Coolant pump oil collection tanks prior to the period of extended operation. | A.2.1.26 | Prior to the period of extended operation. |
| 31. | ASME Section XI, Subsection IWL | Enhance procedure to include the definition of "Responsible Engineer". | A.2.1.28 | Prior to the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 32. | Structures Monitoring Program | Enhance procedure to add the aging effects, additional locations, inspection frequency and ultrasonic test requirements. | A.2.1.31 | Prior to the period of extended operation. |
| 33. | Structures Monitoring Program | Enhance procedure to include inspection of opportunity when planning excavation work that would expose inaccessible concrete. | A.2.1.31 | Prior to the period of extended operation. |
| 34. | Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements | Implement the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program. | A.2.1.32 | Prior to the period of extended operation. |
| 35. | Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits | Implement the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program. | A.2.1.33 | Prior to the period of extended operation. |
| 36. | Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements | Implement the Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program. | A.2.1.34 | Prior to the period of extended operation. |
| 37. | Metal Enclosed Bus | Implement the Metal Enclosed Bus program. | A.2.1.35 | Prior to the period of extended operation. |
| 38. | Fuse Holders | Implement the Fuse Holders program. | A.2.1.36 | Prior to the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 39. | Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements | Implement the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program. | A.2.1.37 | Prior to the period of extended operation. |
| 40. | 345 KV $SF_6$ Bus | Implement the 345 KV $SF_6$ Bus program. | A.2.2.1 | Prior to the period of extended operation. |
| 41. | Metal Fatigue of Reactor Coolant Pressure Boundary | Enhance the program to include additional transients beyond those defined in the Technical Specifications and UFSAR. | A.2.3.1 | Prior to the period of extended operation. |
| 42. | Metal Fatigue of Reactor Coolant Pressure Boundary | Enhance the program to implement a software program, to count transients to monitor cumulative usage on selected components. | A.2.3.1 | Prior to the period of extended operation. |
| 43. | Pressure –Temperature Limits, including Low Temperature Overpressure Protection Limits | Seabrook Station will submit updates to the P-T curves and LTOP limits to the NRC at the appropriate time to comply with 10 CFR 50 Appendix G. | A.2.4.1.4 | The updated analyses will be submitted at the appropriate time to comply with 10 CFR 50 Appendix G, Fracture Toughness Requirements. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 44. | Environmentally-Assisted Fatigue Analyses (TLAA) | NextEra Seabrook will perform a review of design basis ASME Class 1 component fatigue evaluations to determine whether the NUREG/CR-6260-based components that have been evaluated for the effects of the reactor coolant environment on fatigue usage are the limiting components for the Seabrook plant configuration. If more limiting components are identified, the most limiting component will be evaluated for the effects of the reactor coolant environment on fatigue usage. If the limiting location identified consists of nickel alloy, the environmentally-assisted fatigue calculation for nickel alloy will be performed using the rules of NUREG/CR-6909.<br><br>(1) Consistent with the Metal Fatigue of Reactor Coolant Pressure Boundary Program Seabrook Station will update the fatigue usage calculations using refined fatigue analyses, if necessary, to determine acceptable CUFs (i.e., less than 1.0) when accounting for the effects of the reactor water environment. This includes applying the appropriate Fen factors to valid CUFs determined from an existing fatigue analysis valid for the period of extended operation or from an analysis using an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case).<br><br>(2) If acceptable CUFs cannot be demonstrated for all the selected locations, then additional plant-specific locations will be evaluated. For the additional plant-specific locations, if CUF, including environmental effects is greater than 1.0, then Corrective Actions will be initiated, in accordance with the Metal Fatigue of Reactor Coolant Pressure Boundary Program, B.2.3.1. Corrective Actions will include inspection, repair, or replacement of the affected locations before exceeding a CUF of 1.0 or the effects of fatigue will be managed by an inspection program that has been reviewed and approved by the NRC (e.g., periodic non-destructive examination of the affected locations at inspection intervals to be determined by a method accepted by the NRC). | A.2.4.2.3 | At least two years prior to entering the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 45. | Number Not Used | | | |
| 46. | Protective Coating Monitoring and Maintenance | Enhance the program by designating and qualifying an Inspector Coordinator and an Inspection Results Evaluator. | A.2.1.38 | Prior to the period of extended operation |
| 47. | Protective Coating Monitoring and Maintenance | Enhance the program by including, "Instruments and Equipment needed for inspection may include, but not be limited to, flashlight, spotlights, marker pen, mirror, measuring tape, magnifier, binoculars, camera with or without wide angle lens, and self sealing polyethylene sample bags." | A.2.1.38 | Prior to the period of extended operation |
| 48. | Protective Coating Monitoring and Maintenance | Enhance the program to include a review of the previous two monitoring reports. | A.2.1.38 | Prior to the period of extended operation |
| 49. | Protective Coating Monitoring and Maintenance | Enhance the program to require that the inspection report is to be evaluated by the responsible evaluation personnel, who is to prepare a summary of findings and recommendations for future surveillance or repair. | A.2.1.38 | Prior to the period of extended operation |
| 50. | ASME Section XI, Subsection IWE | Perform UT testing of the containment liner plate in the vicinity of the moisture barrier for loss of material. | A.2.1.27 | Within the next two refueling outages, OR15 or OR16, and repeated at intervals of no more than five refueling outages |
| 51. | Number Not Used | | | |
| 52. | ASME Section XI, Subsection IWL | Implement measures to maintain the exterior surface of the Containment Structure, from elevation -30 feet to +20 feet, in a dewatered state. | A.2.1.28 | Ongoing |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 53. | Reactor Head Closure Studs | Replace the spare reactor head closure stud(s) manufactured from the bar that has a yield strength > 150 ksi with ones that do not exceed 150 ksi. | A.2.1.3 | Prior to the period of extended operation. |
| 54. | Steam Generator Tube Integrity | NextEra will address the potential for cracking of the primary to secondary pressure boundary due to PWSCC of tube-to-tubesheet welds using one of the following two options:<br>1) Perform a one-time inspection of a representative sample of tube-to-tubesheet welds in all steam generators to determine if PWSCC cracking is present and, if cracking is identified, resolve the condition through engineering evaluation justifying continued operation or repair the condition, as appropriate, and establish an ongoing monitoring program to perform routine tube-to-tubesheet weld inspections for the remaining life of the steam generators, or<br>2) Perform an analytical evaluation showing that the structural integrity of the steam generator tube-to-tubesheet interface is adequately maintaining the pressure boundary in the presence of tube-to-tubesheet weld cracking, or redefining the pressure boundary in which the tube-to-tubesheet weld is no longer included and, therefore, is not required for reactor coolant pressure boundary function. The redefinition of the rector coolant pressure boundary must be approved by the NRC as part of a license amendment request. | A.2.1.10 | Complete |
| 55. | Steam Generator Tube Integrity | Seabrook will perform an inspection of each steam generator to assess the condition of the divider plate assembly. | A.2.1.10 | Within five years prior to entering the period of extended operation. |
| 56. | Closed-Cycle Cooling Water System | Revise the station program documents to reflect the EPRI Guideline operating ranges and Action Level values for hydrazine and sulfates. | A.2.1.12 | Prior to entering the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
|---|---|---|---|---|
| 57. | Closed-Cycle Cooling Water System | Revise the station program documents to reflect the EPRI Guideline operating ranges and Action Level values for Diesel Generator Cooling Water Jacket pH. | A.2.1.12 | Prior to entering the period of extended operation. |
| 58. | Fuel Oil Chemistry | Update Technical Requirement Program 5.1, (Diesel Fuel Oil Testing Program) ASTM standards to ASTM D2709-96 and ASTM D4057-95 required by the GALL XI.M30 Rev 1 | A.2.1.18 | Prior to the period of extended operation. |
| 59. | Nickel Alloy Nozzles and Penetrations | The Nickel Alloy Aging Nozzles and Penetrations program will implement applicable Bulletins, Generic Letters, and staff accepted industry guidelines. | A.2.2.3 | Prior to the period of extended operation. |
| 60. | Buried Piping and Tanks Inspection | Implement the design change replacing the buried Auxiliary Boiler supply piping with a pipe-within-pipe configuration with leak detection capability. | A.2.1.22 | Prior to entering the period of extended operation. |
| 61. | Compressed Air Monitoring Program | Replace the flexible hoses associated with the Diesel Generator air compressors on a frequency of every 10 years. | A.2.1.14 | Within ten years prior to entering the period of extended operation. |
| 62. | Water Chemistry | Enhance the program to include a statement that sampling frequencies are increased when chemistry action levels are exceeded. | A.2.1.2 | Prior to the period of extended operation. |
| 63. | Flow Induced Erosion | Ensure that the quarterly CVCS Charging Pump testing is continued during the PEO. Additionally, add a precaution to the test procedure to state that an increase in the CVCS Charging Pump mini flow above the acceptance criteria may be indicative of erosion of the mini flow orifice as described in LER 50-275/94-023. | N/A | Prior to the period of extended operation |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
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| 64. | Buried Piping and Tanks Inspection | Soil analysis shall be performed prior to entering the period of extended operation to determine the corrosivity of the soil in the vicinity of non-cathodically protected steel pipe within the scope of this program. If the initial analysis shows the soil to be non-corrosive, this analysis will be re-performed every ten years thereafter. | A.2.1.22 | Prior to entering the period of extended operation. |
| 65. | Flux Thimble Tube | Implement measures to ensure that the movable incore detectors are not returned to service during the period of extended operation. | N/A | Prior to entering the period of extended operation |
| 66. | Number Not Used | | | |
| 67. | Structures Monitoring Program | Perform one shallow core bore in an area that was continuously wetted from borated water to be examined for concrete degradation and also expose rebar to detect any degradation such as loss of material. | A.2.1.31 | No later than December 31, 2015 |
| 68. | Structures Monitoring Program | Perform sampling at the leakoff collection points for chlorides, sulfates, pH and iron once every three months. | A.2.1.31 | Starting January 2014 |
| 69. | Open-Cycle Cooling Water System | Replace the Diesel Generator Heat Exchanger Plastisol PVC lined Service Water piping with piping fabricated from AL6XN material. | A.2.1.11 | Prior to the period of extended operation. |
| 70. | Closed-Cycle Cooling Water System | Inspect the piping downstream of CC-V-444 and CC-V-446 to determine whether the loss of material due to cavitation induced erosion has been eliminated or whether this remains an issue in the primary component cooling water system. | A.2.1.12 | Within ten years prior to the period of extended operation. |

| No. | PROGRAM or TOPIC | COMMITMENT | UFSAR LOCATION | SCHEDULE |
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| 71. | Alkali-Silica Reaction (ASR) Monitoring Program | Implement the Alkali-Silica Reaction (ASR) Monitoring Program. ***Testing will be performed to confirm that parameters being monitored and acceptance criteria used are appropriate to manage the effects of ASR*** | ***A.2.1.31A*** | Prior to entering the period of extended operation. |